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NURSES' ATTITUDES TOWARD COMPUTER USE
FOR POINT-OF-CARE CHARTING

A Thesis
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in
Psychology

by
Steven Adam Marks
September 2001

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ABSTRACT

The purpose of this study was to evaluate the variables that affect nurses' attitudes toward computer use for patient care charting. The participants were registered nurses working in two different Southern California hospitals. The participants were given questionnaires to complete that asked about their computer experience, attitudes toward computers and nursing specialization. Structural equation modeling was used for the analysis. The results indicated that for a community hospital sample, computer experience predicted attitudes toward computers. The same prediction did not hold for a university medical center sample.

ACKNOWLEDGMENTS

I would to greatly thank my committee for their support, understanding and contribution to the completion of this thesis.

DEDICATION

To my wife Jann

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CHAPTER ONE

INTRODUCTION

Computer Use in Healthcare Settings

As healthcare costs increase, healthcare providers continue to look for cost effective methods of providing care to consumers. One promising, cost-reducing method is utilization of computers. For example, a nurse who needs to order medication for a patient can order the medication by selecting from a computer menu instead of filling out a request and then sending it to the pharmacy via a tube system or courier. Using a computer for order entry can lead to a time savings for the nurse, as well as a financial savings for the hospital, and potentially lead to better patient care.

Adderley, Hyde, and Mauseth (1997) found a positive impact on nursing practice with the use of computer charting. They found that entries for vital signs (i.e. blood pressure, heart rate, respiration rate) were more accurate, a time savings was noted, and order accuracy was increased relative to processing medication orders from physicians. Taken together, these results provided nurses additional time to deliver more personalized patient care. The time savings realized by using computers can translate

into more efficient patient care, as well as more favorable nurse to patient ratios.

Order entry is just one example of how nurses or other healthcare providers can use computers to save time and money. Other everyday computer functions that can potentially benefit healthcare organizations include keeping records of patient care, insurance and billing, and training healthcare professionals. Thus, it is easy to see why many healthcare providers use computers for a variety of day-to-day functions.

One of the most extensive uses of computers by healthcare providers is that of Hospital Information Systems (HISs). HISs have been shown to save hospitals money (Lower & Nauert, 1992) and nurses' time (Hendrickson & Kovner, 1990). A HIS can be comprised of a single mainframe system, a grouping of smaller systems that may or may not be networked, or a combination of mainframe and smaller systems. This flexibility allows for HISs to be used for a variety of purposes. Some specific examples of how HISs can be used include providing computerized physician order entry, scheduling patient appointments, ordering pharmaceutical and/or medical supplies, reporting laboratory results, and billing. All of the preceding can be utilized on nursing units and/or ancillary departments

to speed the completion of routine tasks. One vital area of nursing, patient care documentation, has also been influenced by the computer age. However, as Jayasuriya and Caputi (1996) point out, one must consider the importance of how computer technology, incorporated into nursing care, will influence how nursing care is provided.

Methods of Documentation

Utilization of computers to document patient care may serve to decrease the tedium associated with handwritten charts. Hand written charts, also known as paper charts, are comprised of a binder that typically has dividers to organize different categories of information. The different categories include physicians' orders, medication record, practitioner consults, lab results, legal documents, operative reports, and nursing documentation. These different categories may be located in one or more binders for the same patient. Some paper charting systems may consist of two or more binders: one that contains information charted by nurses, such as patient vital signs and medications, and the second binder which contains all other information, such as physician orders, consults, legal documents, and test results. When healthcare providers need information, they need to

identify and locate the correct binder. Hospitals typically keep at least two binders, one for items that are frequently charted by nurses and a chart for all other patient information.

If the hospital uses a functional nursing model, keeping accurate paper charting systems may be even more challenging for the healthcare professional. In functional nursing, a team of nurses cares for all the patients on a given unit; each nurse performs a specific function (Mitchell & Grippando, 1993, p. 221). For example, one nurse would be responsible for administering the medications to all the patients on a given unit, while another nurse would be responsible for taking the vital signs of all patients. In this type of nursing there may be a single chart or multiple charts for medications, a chart for vital signs and other daily patient information, and another chart for physician orders and test results.

The two major problems with paper systems are 1) wasted time looking for charts or specific records within the chart and 2) trying to decipher illegible or sloppy handwriting (Hendrickson & Kovner, 1990). A computer charting system that is located at the bedside can help to eliminate these and other problems associated with paper charting systems.

Point-of-Care Computer Systems

Point-of-care (POC) computer systems are defined as those computer systems that are utilized at the patient's bedside for charting and information exchange related to patient care. A POC system can be established on a specific unit or can be hospital-wide. POC systems can provide faster and more accurate documentation than paper documentation systems. Computer-generated records are easier to read compared to an illegible handwritten record.

Another advantage of POC systems is that less information needs to be synthesized by human observers. For example, if one needs to look at specific information such as vital sign trends, numeric values or graphic trends, these data can be searched for and displayed on a computer screen faster and more easily than flipping through pages of a medical record to locate the required information. Therefore, POC systems can also help to decrease costs associated with providing health care to consumers.

The advantages of POC charting were explored by Kahl, Ivancin, and Fuhrmann (1991). The researchers conducted a study to determine the potential cost savings of POC charting systems. Preliminary studies were conducted for

each nursing unit to evaluate which activities may save nurses time. The activities that were identified as the most promising to save nursing time for nurses were shift-to-shift nurse communication, travel (access to patient information care system), and documentation, which was further broken down into six categories. Some of the documentation categories included tasks such as vital signs entry, intake and output (I/O) fluid computations, and patient care plan development.

The authors projected a potential annual cost savings, based on the activities identified as most promising to save nurses time, of \$1.2 million to \$2.1 million. The authors derived the figures from a "cost savings summary" that identified how many regular hours and over-time hours could potentially be saved when nurses utilized computers to complete nursing activities (i.e. charting). The calculations were based on a rate of pay of \$14.00 per hour and a 20% benefit package. Over-time hours were calculated at 1 1/2 times the regular hourly rate of pay.

In addition to cost savings, another benefit of computer use for nurses is a time savings. Saving nurses time during their shift can translate into greater worker productivity and potentially providing higher quality

patient care. While according to this study, computer use may save nurses time, one must not forget that there is a nursing shortage in this country. Thus, saving a nurse time could lead to better patient care and not necessarily require the nurse to accept a greater number of patients.

In today's healthcare setting, nurses and other healthcare providers must provide more care with less available human resources. Therefore, it becomes important to maximize staff potential in providing patient care. Computer systems, if effectively designed, can increase productivity of nurses (Hendrickson & Kovner, 1990). For example, a time savings could be realized if a nurse could simply read a patient's fluid intake and output totals from a computer screen that automatically calculated the totals instead of taking the time to hand-calculate hourly, 12-hour and 24-hour fluid totals. This automatic calculation saves nurses' time in which they can perform other duties, thus providing better patient care. Therefore, the nurse could spend more time providing other nursing cares such as patient comfort or educating family members about the patient's condition.

Additional support for the benefit of computer use can be seen in a study conducted by Pabst, Scherubel, and Minnich (1996). The authors found that nurses who utilized

an automated documentation system were able to spend more time in providing patient care. Pabst et al., (1996) reported that staff nurses spent 30% less time charting when using computers. These time savings were found to translate into more time spent with patients. The authors translated the percentage of time saved due to computerization to 20 minutes per nurse per shift. If other tasks were computerized, such as order entry by physicians and ordering patient care supplies, additional time savings might be realized.

As stated earlier, with computerized documentation systems, healthcare providers do not need to spend time looking for patient charts. Once a healthcare provider has learned how to use the computer system, authorized staff can access needed patient information rapidly by locating a computer terminal or dialing into the system via modem.

Further evidence indicating that computer use can be beneficial for nurses can be found in Hendrickson and Kovner's (1990) literature review related to the effects of HISS on nursing resource use. The authors reviewed six major studies that were published between 1975 and 1987. Each of the studies evaluated in some way how computerization affected a nurse's allocation of time on tasks. While the studies varied by such things as type of

computer system utilized, year study completed and facility, Hendrickson and Kovner found that computer systems facilitated information exchange between nursing units and ancillary departments. This facilitation of information exchange can in turn save time for nurses. For example, one specific study reviewed by Hendrickson and Kovner (Barrett, Barnum, Gordon, & Pesut, 1975) showed how nurses could save time during shift change report when utilizing a computer.

When shift change occurs, a report is given by the off-going nurse to the on-coming nurse. The nurse report, which is based on a patient care plan, will include information that is related to medical and nursing care for the patient. The time spent in shift change can vary from hospital to hospital. A period of thirty minutes may be all that is allowed for giving report. A single nurse can be responsible for the care of anywhere from one very critical, intensive care unit patient to as many as ten basic care patients. If hospital budgets permitted for greater periods of overlap between nursing shift changes, the on-coming nurse could read the medical record and learn about the patient he/she was going to care for prior to assuming responsibility for the patient's care. Unfortunately, nurses typically do not have the

opportunity to read a patient's chart to learn about the medical condition and treatment plan prior to shift change. During shift change the on-coming nurse must rely greatly on the off-going nurse to provide medical information that is important and accurate. Therefore, a clear and concise method for giving shift report can potentially lead to better patient care.

In hospitals that do not use computers, paper-and-pencil methods are utilized for giving shift report. This method can be cumbersome, confusing, and sometimes inaccurate. As the patient's condition changes and/or tests are completed, the care plan may become difficult to read due to continual erasing and updating. A computer-based care plan would be much easier to read (assuming people can type and spell correctly) compared to a paper chart and would permit for a more organized reading format. Additionally, for caregivers unfamiliar with a particular patient, computerized shift reports may help to decrease omission of information or miscommunication related to patient care (Hendrickson & Kovner, 1990). Therefore, this time savings during shift change can translate into money saved if a hospital is required to pay overtime for nurses who run late during shift change.

Even though there are many benefits to computer use for bedside charting, there are some disadvantages associated with these systems. It would be wise for organizations considering or currently using computer systems to be aware of such disadvantages. While the use of computers for completion of routine care tasks has been shown to save nurses' time and hospitals money (Hendrickson & Kovner, 1990; Lower & Nauert, 1992), there are some disadvantages to implementing and utilizing computers in the hospital setting (Axford & Carter, 1996; Meyer, 1992).

First, one of the major obstacles to implementing a computer system may be the cost associated with purchasing a new computer system. Meyer (1992) reported that approximately 3 percent of American hospitals with 100 or more beds were using POC systems. According to Ruth MacCallum (personal communication, April 11, 2001), President of Midwest Alliance for Nursing Informatics (MANI), only 5% of hospitals in the United States were using computerized patient care documentation systems. A possible reason for the low rate of computer use may be the cost of the system, which can range from \$2,000-\$30,000 per bed. While the cost of systems will probably decrease over time, a computer system remains a large capital expense for many organizations.

Additionally, there are other direct costs that an organization may incur as a result of purchasing a computer system. These costs may include training, to use the system, purchasing upgrades, warranties or system maintenance plans. Other potential costs associated with computer system purchases include closing patient care rooms and relocating the unit during the computer system installation.

The design of the computer charting screens can influence the cost effectiveness of the computer system. Axford and Carter (1996) found that computer users indicated that slow computer response or system downtime can hinder nursing practice. Therefore, poorly designed systems may not save time for nurses and, in fact, lead to additional costs related to charting.

The majority of studies reviewed indicated that these disadvantages are typically minimal in comparison to the advantages of computer use for charting. If hospitals use effectively designed computer systems, train health care professionals to use the system, and are aware of factors leading to resistance, hospitals can effectively incorporate computers to save practitioners time and improve health care.

The studies reviewed for this paper tend to provide a positive review of computer use by nurses. Many studies show how computer use can save nurses time. However, there are potential disadvantages to be aware of related to computer use by nurses. Some of the potential disadvantages related to computer use for bedside charting are discussed by Bongartz, 1988; Jacobson, et al., 1989; Faaoso, 1992.

Bongartz (1988) points out that the system itself may relate to why nurses have less positive attitudes to computer use. If a nurse believes that the computer system is less effective compared to "paper and pencil" methods, the nurse may be less apt to use the new technology. Thus, if a nurse finds that it is quicker and easier to use traditional charting methods, she/he may become resistant to using computerized methods for charting patient care.

In addition, if a nurse finds the computer system difficult to use, she or he may become anxious about her or his ability to use the computer. Therefore, managers may recognize staff members expressing varying levels of anxiety. One factor that may mitigate computer anxiety for nurses is prior computer experience. According to Jacobson et al., (1989), if nurses have computer experience or own a home computer (even if it is not used), they experience

less anxiety toward using computers at work. Therefore, individuals with no computer experience may resist using computers more so than individuals who have computer experience (The factors of computer experience and computer anxiety will be discussed in more detail in the next chapter). Thus, understanding how change happens can benefit those individuals directly affected by change and organizational leaders. Kurt Lewin (1958) provides a model in which to understand organizational change. Lewin describes three stages (unfreezing—making people aware of need for change, change—moving from old behaviors to new ones and refreezing—making new behaviors permanent) of change. According to Lewin, change can only occur after the forces resisting change are decreased, therefore allowing change to take place. Finally, Faaoso (1992) discusses the potential problems with open technology systems and maintaining patient confidentiality.

Many hospital computer systems have terminals in labs, on the units and in physician offices. While it is the responsibility of organizations to implement a system that protects patient information, it rests with the healthcare provider who is using the system at any given time, to make sure it is being used in a manner consistent with organizational policy. As a result, healthcare

providers must make sure computer screens are not viewable to the general public.

Additionally, it may be difficult for individuals from outside facilities to quickly navigate through medical record reports that have been generated from hospitals utilizing computer-charting systems. This inability to find information quickly could be directly related to the configuration of the report. For example, a patient is transferred from one hospital to another. The hospital transferring the patient utilizes computer charting for bedside care. The hospital receiving the patient utilizes paper and pen system for charting care. The nurses and physicians at the hospital receiving the patient may have a difficult time locating patient information quickly as a result of the unfamiliarity of the computer generated patient chart.

Organizational leaders must address the disadvantages of computer use to improve features of the final system. Current literature provides the basis for addressing some of these potential disadvantages. Consequently, anxiety and attitudes of nurses related to computer use in providing patient care have been studied by many researchers, and will be addressed in the next section.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Anxiety of Nurses Related to Computerization

If a healthcare organization is going to implement a computer charting system, it would be wise for organizational leaders to consider the possible anxiety individuals may exhibit as a result of utilizing a new method for record keeping. Computer anxiety is anxiety related to the use of computers or new computer technology (Negron, 1995). According to Zimbardo (1985), anxiety in general can be exhibited as three of the four following groupings 1) motor tension, such as jitters, fatigue or inability to relax, 2) autonomic hyperactivity, such as sweating, upset stomach or a pounding heart, 3) apprehensive expectations, such as worrying or anticipation of some self misfortune, and 4) vigilance and scanning, which includes distraction, poor concentration and difficulty sleeping. Consequently, these symptoms or manifestations of anxiety can inhibit a person's performance. In the case of a nurse experiencing computer anxiety and whose performance is affected, she/he may provide a lower quality of care to the patient.

Computer anxiety has been studied by several researchers (e.g. Martocchio, 1994; Morrow, Prell, McElroy 1986). According to Rakes (1989) anxiety is a leading emotion experienced by individuals required to use computers in the workplace. Therefore, it is important to identify potential causes of computer anxiety. Morrow et al. (1986) conducted a study in which they examined potential correlates of computer anxiety. The researchers found that high scores on prior computer experience, computer knowledge, locus of control, automated teller machine (ATM) use, anxiety toward math, and video game avoidance were significantly related to computer anxiety. While many of the factors were significantly related to computer anxiety, computer knowledge accounted for 20% of the variance out of 36% for all of the correlates.

Another study found nurses as a whole, tend to exhibit more anxiety toward computerization than clerical and administrative staff (Henderson, Deane, & Ward, 1995). The results of their study may be due to the different expectations associated with each of the different types of jobs. For example, when clerical staff are hired for a position, job qualifications may include familiarity with computer software programs and the ability to type a specified amount of words per minute. Nurses, on the other

hand, are not typically required to provide prior experiences related to computer use or typing abilities. Therefore, it is important for organizational leaders to create computer implementation plans that at least consider potential anxiety levels of the future computer users.

Some of the research related to computer anxiety has specifically focused on the nursing profession (Jacobson et al., 1989; Jayasuriya & Caputi, 1996; Negron, 1995). Jacobson et al., (1989) conducted a study in which they measured computer anxiety among nursing students, nursing educators, staff nurses, and nursing administrators. Their study helped to uncover a factor that may contribute to computer anxiety for nurses--educational background.

The subjects completed the Oetting Computer Anxiety Scale (Oetting, 1983). Subjects included individuals in baccalaureate nursing programs, graduate nursing and non-nursing programs, bedside nurses, nurse managers, and nurse educators. Nurses, as a group, were found to exhibit "mild" computer anxiety. Furthermore, a higher educational level was associated with less computer anxiety. Analysis revealed that nurses with diplomas and Associate of Science degrees exhibited a significantly higher computer anxiety than did nurses with baccalaureates. Additionally,

graduate students in non-nursing programs showed the least amount of anxiety toward computer use when compared to graduate nursing students and staff nurses.

However, there are some potential limitations in this study. The sample did not include students from diploma, associate degree, and doctoral nursing programs or nurses from small or rural hospitals. Therefore, potential subjects who may have exhibited higher levels of computer anxiety were not included in the sample. Nurses and nursing students, as a group, may exhibit more anxiety than actually reported in this study.

Anxiety can be a factor that may hinder individuals' computer use. Individual anxieties may be short-lived as a result of prior computer experience and/or time spent utilizing the computer system after implementation. While computer anxiety may result as an overwhelming physical and/or emotional response for a nurse, computer anxiety can also be a "temporary emotional trait" that can decrease over time with positive computer experiences (Cambre & Cook, 1987).

While it is clear anxiety can influence how an individual responds to computer technology, attitudes toward computers can also play a major role in acceptance or resistance of computer use by nurses. Many studies have

examined factors that potentially influence attitudes of nurses related to computer use.

Attitudes Defined

Attitudes are defined as the tendency to respond in a specific way (Zimbardo, 1985, p. 617). Attitudes are based on three elements: beliefs, affects, and behavioral dispositions. Beliefs are opinions about what is true or likely. Affects are emotional thoughts related to attractiveness or repugnance of a particular object or thought. Behavioral dispositions are tendencies to take action in a particular manner (Zimbardo, 1985, p. 617). Consequently, attitudes tend to be fairly stable attributes, which may be malleable to some degree. However, negative attitudes may be very difficult for an organization to overcome. Thus, when an organization is considering implementing a new computer system, attitudes of the individuals affected by the new technology are important to evaluate.

According to Allport (1968), attitudes are modifiable by experience. Therefore, organizations utilizing new technology can influence attitudes of organizational members through such things as pre-training prior to a new system implementation. Pre-training can lead to more

positive attitudes of individuals and greater acceptance of the new technology. Many studies have been completed which examine nurses' attitudes toward computerization (Bongartz, 1988; Brodt & Stronge 1986; McBride & Nagle, 1996; Scarpa, Smeltzer, & Jasion 1992; Simpson & Kenrick; 1997).

Attitudes Toward Computerization

There is a vast array of information in the literature related to computer use by nurses. Evaluation of attitudes toward computerization can help to 1) determine if the group affected by the new technology have positive or negative attitudes, 2) identify individuals who may serve to be good trainers, 3) create a more tailored training program, and 4) serve as a tool for obtaining additional information about prospective job candidates. For example, if a group of individuals has a negative attitude toward computerization, sensitizing the group to computer technology prior to the actual system implementation may serve to reduce those negative attitudes.

Studies have been conducted on evaluating different factors that may influence attitudes toward computer use such as nursing specialty, basic demographic information

(such as age and highest degree completed) and prior computer experience (Bongartz, 1988; Bradley, 1993; Brodt & Stronge, 1986; Burkes, 1991; McBride & Nagle, 1996; Scarpa et al., 1992; Simpson & Kenrick, 1997; Sultana, 1990). The results of these studies are mixed. Since attitudes can be the result of a multitude of factors, past studies will help to identify those factors, which may or may not influence attitudes toward computer use for nurses.

Nursing Specialty

One of the factors examined by many researchers as to whether or not it influences nurses' attitudes toward computer use by nurses is nursing specialty (Bradley, 1993; Brodt & Stronge, 1986; Scarpa et al., 1992; Simpson & Kenrick, 1997; Sultana, 1990). A nurse's specialty can be defined as the area in which the nurse works or performs patient care on a regular basis. While all nurses are trained to a similar standard, the knowledge or standards in a nursing specialty may differ. For example, a nurse who specializes in cardiac care, would work in the cardiac intensive care unit caring for patients with heart conditions. There is a knowledge base that a cardiac nurse would need to possess that would be different for nurses

in other nursing specialties (i.e. med/surg nursing or obstetrical nursing). A cardiac nurse would need to have a great understanding in such topics as identification and importance of specific electrocardiogram (EKG) changes, dosages of medication, side effects and incompatibilities of common cardiac medications, appropriate diets for cardiac patients and appropriate activity levels for cardiac patients.

One of the earlier studies that evaluated nursing specialty was conducted by Brodt and Stronge (1986). The authors used nurses from a community hospital in a Midwestern state. The researchers utilized the survey they had designed the prior year (Stronge & Brodt, 1985). The participants were divided into seven different groups based on nursing division. The nursing divisions were obstetrics, psychiatric, medical/surgical, pediatric rehabilitation, critical care, and administration. Using a Scheffe multiple comparison analysis significant differences were found for three of the nursing groups. Nurses working on the pediatric rehabilitation unit and nursing administrators had significantly better attitudes toward computer use when each was compared to medical/surgical nurses. Brodt and Stronge speculated that these differences may be due to differing educational

levels of the nurses working in the different areas or varying job responsibilities associated with the different groups.

Other researchers have attempted to ascertain if nurses' attitudes toward computer use differed based on nursing specialty (Bradley, 1993; Scarpa et al., 1992; Simpson & Kenrick, 1997; Sultana, 1990). Sultana (1990) attempted to replicate the Brodt and Stronge (1986) study. Participants were nurses from a district general hospital in the United Kingdom. The nurses were divided into five groupings 1) medical, 2) surgical, 3) general care, 4) recovery, and 5) ophthalmic units. This author did not find significant differences between the nurses working in the different nursing areas. This finding may be due to the small sample size used for the study ($n = 58$) or not enough differentiation between nursing specialty.

Scarpa, et al., (1992) did not find differences between nurses working in a clinical capacity compared to nurses working in administrative roles. Scarpa, et al. (1992) may not have found a difference due to the small sample size and method used for dealing with missing data. Out of the 136 questionnaires returned only 110 were completely filled out. Of the additional 26 questionnaires, 1 to 2 answers were omitted from 76.9% of

the surveys. The authors replaced the missing responses with the mean response for the question.

While the above mentioned studies failed to find a significant difference between nursing specialty and attitudes toward computer use (Scarpa, et al., 1992; Sultana, 1990) others have found significant differences (Bradley, 1993; Simpson & Kenrick, 1997). Simpson and Kenrick (1997) used the Stronge and Brodt (1985) questionnaire to survey 208 nurses working in a general hospital in the United Kingdom. They found that nurses working on the elderly care unit, medical and rehabilitation units had significantly more negative attitudes toward computer use compared to all other units. The authors state that the nurses working on the elderly care unit, medical unit and rehabilitation unit may be so busy trying to meet the basic needs of their patients, that computer use is viewed as unnecessary. Another possible explanation for these different findings may be that the nursing specialty was well differentiated and that there was a larger sample compared to other studies.

Other researchers have also utilized the Stronge and Brodt (1985) questionnaire to assess nurses attitudes toward computer use. Bradley (1993) assessed 247 nurses' attitudes toward computerization in different nursing

divisions (pediatrics, maternal-infant, critical care, medical/surgical and administrative). Bradley found that nursing administrators had the most positive attitudes toward computer use and maternal-infant nurses had the most negative attitudes. These findings are consistent with what Brodt and Stronge (1986) found for administrators and maternal-infant nurses. Further evaluation of this factor may provide additional insight into whether or not nursing specialty truly influences nurses' attitudes toward computer use.

Age

Another factor that has been examined in relationship to attitudes toward computer use by nurses was age (Bongartz, 1988; Scarpa et al., 1992; Simpson & Kenrick, 1997; Stronge & Brodt, 1985; Sultana, 1990). Again, as with the prior factor, nursing specialty, research results are mixed. The majority of studies have not found significant differences between age and attitudes toward computer use (Bongartz, 1988; Scarpa et al., 1992; Stronge & Brodt, 1985; Sultana, 1990).

One study that did find a significant correlation between age and computer anxiety was Simpson and Kenrick (1997). Simpson and Kenrick (1997) utilized the Stronge

and Brodt (1985) survey to evaluate British nurses' attitudes toward computerization. While they found nurses' attitudes, in general, to be on the positive side favoring computerization, they found age to be significantly and negatively related to attitudes toward computers. The younger nurses, age 29 and younger), had more positive attitudes toward computer use compared to the two older groups of nurses, age 30-39 (Mann-Whitney $U = 2186.5$; $p = 0.017$) and age 50 and older (Mann-Whitney $U = 261.0$; $p = 0.014$).

While these results contradict prior findings, the authors point out potential reasons for the difference. Simpson and Kenrick's (1997) study was conducted as much as 10 years after some of the other studies. The difference may represent a general change in nurses' attitudes toward computer use. Furthermore, the younger nurses had less experience in nursing compared to the older participants. Thus, the younger nurses may not have experienced the actual impact of computer use in hospitals. Finally, cultural differences may exist between the participants used for the studies. The participants for Simpson and Kenrick's (1997) study were from the United Kingdom; the participants from the other studies were from the United States.

Simpson and Kenrick's (1997) study points out how demographic factors could represent other factors such as the generation gap and/or cultural differences. Fortunately, all the studies reviewed analyzed many factors when examining nurses' attitudes toward computer use. However, Simpson and Kenrick's (1997) study was the most recent one completed and, as stated earlier, may represent a change in attitude toward computer use or technology in general. This "change" in attitude may be due in part to the wide use of computers in schools. Thus, nurses who pursue educational goals beyond the most basic nursing degree may receive much greater exposure to computer use.

Educational Level

Many of the studies discussed have addressed educational level as a potential factor that influences nurses' attitudes toward computer use. Brodt and Stronge (1986) surveyed nurses who ranged in educational level from Licensed Practical Nurse (LPN), to Bachelor of Science in Nursing (BSN). Their analysis revealed a significant difference between educational level and attitudes toward computer use. Brodt and Stronge found that LPNs, who receive the least amount of education

compared to all other levels of nurses, had the least favorable attitudes toward computer use.

While Brodt and Stronge (1986) did find a difference between educational level and computer attitudes, many of the studies reviewed have not (Bradley, 1993; Scarpa et al., 1992; Simpson & Kenrick, 1997; Sultana, 1990). The differences between these studies can possibly be accounted for by the sample used for each study. For example, Sultana (1990) and Scarpa et al. (1992) had relatively small samples ($n = 58$ and $n = 136$ respectively). While the sample size used by Bradley (1993) was most likely adequate, the distribution of participants within the different nursing degree levels may have influenced the results (almost 65% of the sample had a baccalaureate degree or higher). Furthermore, Simpson and Kenrick (1997) surveyed nurses who were educated in the United Kingdom. The disparities call into question the possible difference in educational programs related to computer use in the different countries. However, the relationship of nurses' education level to computer attitudes is less diverse compared to the other factors examined in literature.

Experience with Computers

The one factor that consistently relates to attitudes toward computer use by nurses is prior computer experience. Some studies have attempted to identify specifically how prior computer experience influences nurses' attitudes toward computer use (Bongartz, 1988; Bradley, 1993; Burkes, 1991; McBride & Nagle, 1996; Scarpa et al., 1992).

Bongartz (1988) utilized the Stronge and Brodt (1985) survey to ascertain the attitudes held by two different groups of nurses; one group with computer experience in the hospital setting and one without work-related computer experience. The participants worked in two different hospitals. The user group (n = 440) worked in a hospital that utilized computers for tasks such as order entry and test result reporting. The non-user group (n = 277) did not use computers in the hospital. The results of the study indicated that both groups had positive attitudes toward computers. However, the analysis found non-users had slightly better attitudes toward computers. Therefore, prior computer experience did not positively affect attitudes as was predicted.

There are some possible explanations as for why prior computer experience did not positively affect attitudes in

this study. First, the nurses working at the hospital utilizing computers may not have been very satisfied with the system in use, perceiving computers as less effective. Secondly, both samples included licensed practical nurses (LPNs). There were a greater number of LPNs in the user group (n = 80) compared to the non-user group (n = 45). Since LPNs require less schooling compared to registered nurses, it is possible that educational level confounded the results.

In another study, Burkes (1991) found that a subject's prior computer experience was negatively related to satisfaction with computer use. The sample consisted of full-time and part-time intensive care unit (ICU) nurses. Subjects who had greater computer experience were less satisfied with computerized charting. These findings contradict the results of other studies (Bradley, 1993; Brodt & Stronge, 1986; Scarpa et al., 1992). The author explains that this difference may be due to the "uniqueness" of the computer system used and/or skewed responses from the subjects due to being surveyed during a time of staffing problems and increased overtime demands.

Bradley (1993) found that personal computer use and computer education classes/lectures related to computer use were all positively correlated with nurses' attitudes

toward computerization. While computer use was correlated positively with attitudes, mere ownership of a personal computer did not correlate. The researcher found that frequency of home computer use was an important predictor of positive attitudes toward computer use. Moreover, Scarpa et al., (1992) found a significant relationship between prior computer use and positive attitudes toward computerization.

McBride and Nagle (1996) conducted a study in which prior computer experience and knowledge was evaluated in greater detail compared to other studies (Bradley, 1993; Scarpa et al., 1992; Sultana, 1990). The authors broke down computer experience into categories related to use within different environments (i.e. work and school) and familiarity with different computer applications (i.e. word processing and spreadsheet). While this study compared student nurses and registered nurses, it brings out the importance of how different types of computer experience may relate to different levels of nursing experience. McBride and Nagle (1996) found that the nursing students, as a group, had a greater amount of computer experience compared to registered nurses. Even though there was a difference in computer experience, the

difference was not significant in mean attitude scores of the two subject groups.

Major Factors Identified in the Questionnaire

The Nurses' Attitudes Toward Computerization

Questionnaire (NATC) survey is a survey that has been utilized by many researchers to study nurses' attitudes toward computer use. The survey identified six major areas of issues for nurses related to computer use. The areas identified are 1) job security, 2) legal ramifications, 3) quality of patient care, 4) capabilities of computers, 5) employee willingness to use computers, and 6) benefit to the institution.

However, as will be discussed later, some studies (McBride & Nagle, 1996; Scarpa et al., 1992; Schwirian, Malone, Stone, Nunley, & Francisco, 1989) have since identified less than six subscales that have statistical support for significance.

In some studies, factor analyses were conducted on the Stronge and Brodt (1985) survey to evaluate for major attitudinal areas that may emerge. The results of these studies are mixed. For example, Schwirian et al., (1989) conducted a study in which a 17 item variation of the NATC questionnaire was utilized. A factor analysis revealed

three major areas related to computer attitudes emerged 1) computers and patient care, 2) computer and personal security, and 3) general attitude toward computers. Other studies have also revealed three major areas or factors that emerged as a result of factor or principle components analysis (McBride & Nagle, 1996; Stockton & Verhey, 1995). McBride and Nagle (1996) identified three factors for nurses 1) nurses' work, 2) organizational issues, and 3) barriers to computer use. While Stockton and Verhey (1995) also found three factors, the authors did not name the factors. However, there are other studies that have identified greater than three factors (Scarpa et al., 1992; Stronge & Brodt 1985). Scarpa et al., (1992) conducted a principle components analysis with orthogonal rotation and found that five factors emerged: 1) nursing efficiency, 2) computer inefficiency, 3) agency and societal impact, 4) limitations of computers, and 5) confidentiality of patient data.

While these studies identify and name the major factors differently, there is consistency to how the questions load on a given factor. The authors that name only three major factors incorporate broader categories that include fewer factors named by other studies. Therefore, only three factors compared to five or six are

revealed. For example, Scarpa et al., (1992) identified agency and societal impact as a major factor. This factor was comprised of questions four and eighteen. When compared with McBride and Nagle (1996), questions four and eighteen loaded on a broader factor named organizational issues.

The research related to how many factors are identified from the NATC questionnaire is mixed. The research identifies anywhere from three to six factors that emerge from the NATC questionnaire. The authors of the NATC questionnaire (Stronge and Brodt, 1985) identified six factors (job security, legal ramifications, quality of patient care, capabilities of computers, employee willingness to use computers, and benefit to the institution). While most of the other research conducted on the NATC questionnaire identified less than four factors. Additional information related to the NATC questionnaire will be presented in the next section.

Variable Selection

It is clear that there are multiple factors that can influence nurses' attitudes toward computer use. Eight variables were selected for this study based on literature review (the variables are described in greater detail in

the next section). The variables were internet use at home, number of computer classes taken, software use, system effectiveness, nursing specialty and three factors comprising the NATC questionnaire (barriers to use, organizational issues, nurses' work). The rationale for utilizing three factors as predictors of NATC questionnaire will be in greater detail discussed later.

All of these variables (except for internet use at home) were selected for this study because of the extensive research that has been completed, thus providing a strong theoretical basis for utilizing each of the variables in this study. The variable Internet use at home (while not studied by other researchers) was used in this study because of the prevalence of Internet use in the United States (at the time this study was conducted). Even though Internet use has not been studied by prior researchers (related to nurses' attitudes toward computer use), it is a computer-based application that may affect attitudes toward computer use.

CHAPTER THREE

METHODOLOGY

Purpose of Study

This study explored potential factors that have not been sufficiently explored in the literature. This study examined nurses' attitudes toward computer use and prior computer experience in greater detail and compared the attitudes of two groups of nurses utilizing different computer charting systems.

Participants

Participants for this study included male and female registered nurses from two different medical facilities. These individuals had a minimum of associate degrees in nursing and were all working full-time, providing bedside patient care (see Table 1).

One group of nurses worked in a University teaching hospital setting taking care of ICU patients. These nurses used the Hewlett Packard CareVue 9000 computer charting system to document patient care.

The other group of nurses worked in a community hospital setting taking care of patients in a variety of settings (ICU, Medical/Surgical acute care and Telemetry).

All of these nurses utilized the Meditech system for documenting patient.

Table 1.

Descriptive Data for the University Medical Center and Community Hospital Groups

	University Medical Center (n = 63)	Community Hospital (n = 41)
Mean age of participants	36 (n = 62)	36 (n = 40)
Gender	Female 81% (n = 63) Male 19%	Female 90.2% (n = 41) Male 7.3%
Highest degree obtained	RN AA/AS 38.1% RN BSN 54% RN Non-RN BA/BS 6.3% RN Masters 1.6%	RN AA/AS 61% RN BSN 36.6% RN Masters 2.4%
Specialty	ICU-100%	ICU-39% Med/surg-41.5% Tele-19.5%

Two Computer Systems Discussed

There are many different types of computer systems currently being used for charting patient care, care plans, and vital sign information. Since the subjects surveyed for this study work in organizations that utilize two different computer-charting systems, the different systems are described in detail. The reason for evaluating the different systems is that the computer systems themselves may prove to be factors that may influence an individual's attitude.

The two systems discussed are the Hewlett Packard CareVue 9000 and Meditech. The Hewlett Packard system is used at a 620+ bed teaching hospital in Southern California and had been in place for three years (at the time of the study). The Meditech system is utilized at a 170+ bed community hospital in Southern California and had been utilized for two years (at the time of the study).

The Hewlett Packard's CareVue 9000 system has interfaces with vital sign monitors, ventilators, and invasive monitoring devices (such as pulmonary artery catheters and arterial lines) and other features to speed entry of information related to nursing charting. Furthermore, the CareVue 9000 system automatically calculates fluid balances for 12 hour, 24 hour, and length of stay time periods, provides for computerized care plans and provides default settings for charting routine site checks, such as intravenous sites.

The Hewlett Packard CareVue system is set up as a mobile workstation that contains a keyboard, a trackball and a 15" color monitor. Each mobile station can be moved from one patient room to another. A computer interface cable plugs into outlets located in each patient room, which communicates with a main server. Patient information on any patient admitted to a unit can be accessed from any

station by simply selecting the name of the patient a caregiver wants to review. Additionally, the CareVue system is configured by the facility utilizing the system. Therefore, the individual charting needs of the hospital can be programmed on site into the computer system.

The Meditech system is more portable than the Hewlett Packard system and possesses different options for charting. For example, the Meditech system provides a hand-held peripheral unit that can be utilized for charting patient assessments, vital signs information and obtaining patient care related information such as laboratory results. This portable unit is linked to a desktop unit to complete the system. The Meditech system under evaluation for this study does not have an interface with vital signs monitors. Therefore, nurses are required to enter more patient related information into the system. Furthermore, the way the hand-held unit is set up requires the nurse attempting to chart to scroll through many screens until the desired screen shows for charting. This feature could lead to a time delay in charting or giving report. However, the desktop unit allows for easier movement throughout the charting screens. According to one source at a hospital using the Meditech system, nurses use

the desktop units for giving report (C. Areffi, personal communication, February 9, 1998).

The Meditech system however, does have automated calculations of fluid totals and patient information can be accessed by physicians and administrative nurses from home via modem. Meditech also has an automated care plan function. The care plan is automatically updated when the nurse charts routine information (unlike the Hewlett Packard CareVue system). For example, if a nurse documented that she/he instructed a patient on how to do something related to his or her care, the care plan would reflect the teaching that was provided. The Meditech system also provides default settings that can be used in many of the assessment screens. The default screens are best utilized from the desktop terminal. A potential downfall (from a time savings standpoint) with this system is that information needs to be uploaded (i.e. laboratory results) into the hand-held or downloaded to a base unit to maintain current patient care related information in the peripheral hand-held unit. This system also does not require as much physical space for system use when compared to other systems, such as Hewlett Packard CareVue 9000. Finally, the Meditech system can also be configured for individual hospital charting needs.

The Nurses' Attitudes Toward Computerization Questionnaire

The Stronge and Brodt (1985) Nurses Attitudes toward computerization questionnaire was utilized for this study. The reason the NATC questionnaire was used for this study was that it had been utilized and evaluated by many researchers (McBride & Nagle, 1996; Scarpa et al., 1992; Schwirian et al., 1989; Stockton & Verhey, 1995). Permission to use the survey for this study was obtained from the first author of the survey.

Stronge and Brodt (1985) developed this survey (see Appendix A) to specifically measure the attitudes of nurses toward computerization (NATC). The survey contains twenty Likert-type questions and brief demographic questions. The Likert-type questions measure responses on a five-point scale with anchors of "strongly agree" and "strongly disagree". They are intended to measure the major issues for nurses related to the use of computers and are not related to specific computer systems. The issues identified were based on a literature review conducted during the survey design.

The demographic data includes age, gender, years worked as a nurse, nursing degree obtained, experience

with computers, length of computer experience, years worked at hospital, and job title.

Stronge and Brodt (1985) evaluated questionnaire items for content validity by comparing the statements to the six areas identified as issues for nurses related to computer use by nurses. The Spearman-Brown formula was used to assess the internal consistency of the 20 Likert-type questions. Stronge and Brodt (1985) obtained a split-half reliability coefficient of .90. Thus, all of the items were included in the questionnaire.

For this study, the nurses' attitudes toward computers survey were broken into three variables. The variables were created based on the factor loading results of the McBride and Nagle (1996) study. The factors were identified after the authors conducted a principal components analysis (PCA) with varimax rotation in SPSS/PC. The questions loaded (in order of highest factor value) on the following factors: nurses work (rnwk_nat) questions 19, 3, 17, 13, 14, 8 and 1; organizational issues (org_nat) questions 9, 20, 18, 15, 6, 7 and 4; barriers to use (bari_nat) questions 12, 11, 2 and 5. The items were scored on a 1 to 5-point scale. Item numbers 3, 8, 13, 14, 17, 19 were reversed scored. This was done in order to create consistency with the point value of all

questions on the survey. The remaining items were all negatively worded. Therefore, the higher a participants score, the more positive their attitudes are towards computers use. A mean score was obtained for each factor and reported to two decimal places.

Demographics Questionnaire

Subjects were required to complete a demographics questionnaire for this study. The demographics questionnaire contains questions related to age, highest degree obtained, unit worked on, years as a nurse, computer use at home, computer use at work, computer classes taken and internet use. Questions were also asked of each participant related to their perceptions of the effectiveness of the computer system.

Hypotheses

Among nurses, prior computer experience consistently relates to more positive computer attitudes. Therefore, hypothesis one states:

Greater prior computer experience as measured by 1) internet use, 2) computer classes and 3) number of software programs used, will predict strong positive attitudes toward computer use by nurses as measured by NATC scores.

The research evidence on nursing specialty has been mixed. Some studies have found different attitudes among different specialties, with other studies finding no differences among specialties. Because relatively few nursing specialties are likely to be represented, no differences are expected in this study. Hence, hypothesis two states:

Nursing specialty will not predict attitudes toward computer use by nurses as measured by NATC scores.

As indicated by prior research, effectiveness of a computer system may affect attitudes towards computer use. Since the research also indicates that individuals who have positive thoughts about computers typically have more positive attitudes (toward computers), hypothesis three states:

Perceived computer system effectiveness will predict positive attitudes toward computer use by nurses as measured by NATC scores.

Due to the theoretical nature of structural equation modeling (the removal of error variance from the model), it is assumed that measurement model and structural model will be the same. Therefore, hypothesis four and five state:

The measurement models in both groups will be equivalent.

The structural models in both groups will be equivalent.

Method of Analysis

The factors used for this study are those identified by McBride and Nagle, 1996 (A factor analysis was not done for this study due to the small sample size.). McBride and Nagle utilized a principle components analysis with varimax rotation and identified the following three factors: 1) nurses' work, 2) organizational issues and 3) barriers to use.

Predictability of the variables were examined, with structural equation modeling (SEM), using EQS 5.7. Structural equation modeling allows for evaluating more than one hypothesis at a time. SEM is the only analytical method that can be used for examining all the relationships completely and simultaneously (Ullman, 1996).

A single group and two-group model were used to examine the data. To estimate the population parameters for each model, the maximum likelihood (ML) method was used in this study. Then the comparative fit index (CFI;

Bentler, 1988) was utilized to assess the fit of each individual model. After assessing the fit of each model, a chi-square difference test was performed to evaluate if one model could describe both groups. Hypotheses testing was then performed, constraining various parameters across groups.

Description of Variables

The variable *hours of software use* (hrs_sftw) was created by obtaining the summed hours of use for the following software programs: word processing, financial, spreadsheet, presentation, desktop publishing software, scanning, games, programming, educational, organizational and graphics.

The variable *Internet use at home* (nethome) was created by taking the hours of Internet use at home as reported by each participant. Some participants reported having Internet access at home, but did not report any hours of usage (there were two participants [#34 and #59] for University Medical Center group and three participants [#2, #20 and #22] for the Community Hospital group in this category). For the purpose of this analysis, these responses were coded as zero.

The variable *how many computer classes taken* (compclas) was created by taking the summed number of computer classes taken by each participant. The nurses' attitudes toward computers survey contained three variables: *nurses' work* (rnwk_nat), *organizational issues* (org_nat) and *barriers to use* (bari_nat).

The variable *system effectiveness* (syseffec) was created by taking the mean score for the responses to system questions 1 to 25. The variable *special* represented the nursing specialization of the participants surveyed.

The Hypothesized Model

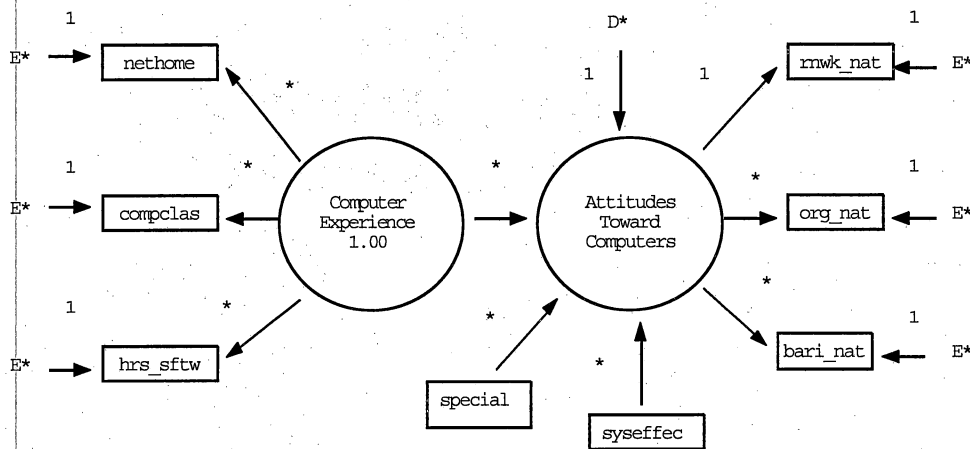
Using EQS, relationships for two different groups were examined between computer experience, a latent variable with three indicators (Internet use at home, computer classes taken, hours of software use per week) and attitudes toward computers, a latent variable with three indicators (nurses' work, organizational issues and barriers to use). It was hypothesized that computer experience would predict attitudes toward computers. Also included in the model were measurements of overall computer system effectiveness and nursing specialization (*special*). It was further hypothesized that 1) perceived system effectiveness would predict attitudes toward

computers and 2) nursing specialization would not predict attitudes toward computers.

The hypothesized model is presented in Figure 1.

Figure 1.

The Base Hypothesized Model: Shows Hypothesized Variable Relationships



Circles represent latent variables (variables that are not observable) and rectangles represent measured variables (variables that are observable). The relationship between variables are represented by lines. Each line indicates a hypothesized relationship between the variables. A line with arrows at both ends indicates covariance between the two variables. If there are no lines present between two variables, no relationship is hypothesized. Additionally, all of the variables in the

model have either arrows labeled with *E* (errors) pointing to measured variables or *D* (disturbances) pointing to latent variables. These paths were representative of error or residual that were not predicted by the IVs.

Assumptions

Assumptions of multivariate normality and linearity were evaluated through SPSS/PC+ and EQS. There were no univariate outliers, but multivariate outliers were detected. Using Mahalanobis distance, one multivariate outlier was detected for each of the sample groups (University Medical Center and Community Hospital). The data for each outlier were reviewed and no apparent reason could be discovered for why each group had one multivariate outlier. Therefore, each outlier was retained for the analysis and the baseline models were each run with the robust (robust is a statistical correction for non-normality) statistics available in EQS. The group model analysis was performed on a total of 104 participants ($n = 63$ for the University Medical Center, $n = 41$ for the Community Hospital). There were no missing data.

CHAPTER FOUR

RESULTS

The demographic information was analyzed for both groups. *t*-tests were performed and show that four of the demographic factors were significantly different (length of computer ownership by month, self-efficacy scores, system effectiveness scores, system satisfaction scores). The results are presented in table 2.

After evaluating the demographic data, structural equation modeling was performed. Analyses were conducted independently on each model to evaluate H1, H2, and H3 (H2 was not evaluated for the University Medical Center group due to the lack of variation within the group--all participants were critical care nurses). After conducting analyses on each model, the models were evaluated for fit of measurement and structure (H4, H5). The University Medical Center group was evaluated (see Figure 2). A significant independence chi-square of 132.086 [df = 21], $p < .001$ was obtained (The independence model chi-square tested whether the variables within each group were uncorrelated).

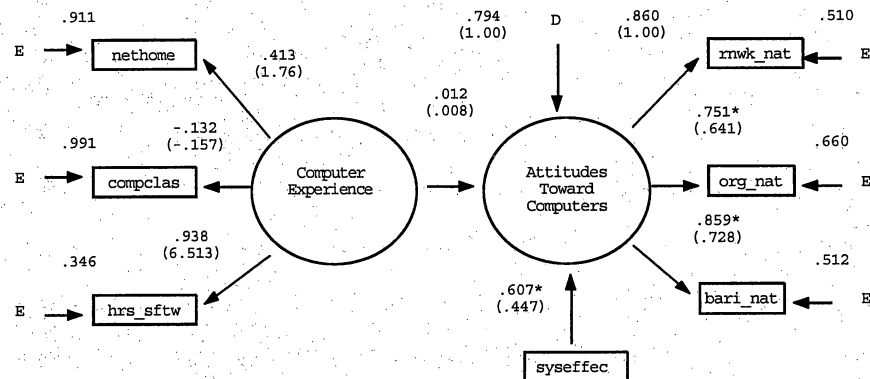
Table 2.

Descriptive Data for the University Medical Center and
Community Hospital Groups

	University Medical Center (n = 63)	Community Hospital (n = 41)	t scores * significant p < .05
Mean # of months as a nurse	112.524	140.756	1.44
Mean # of months worked at current hospital	105.175	83.732	1.29
Computer used for documenting patient care prior to current job	95.2% have not used computers for charting pt care prior to this job.	75.6% have not used computers for charting pt care prior to this job.	
Percentage who own a computer at home	79.4%	48.8%	
Mean length of home computer ownership by month	55.810	17.293	4.64*
Percentage who have internet access at home	58.7%	46.3%	
Mean # of hours per week spent on internet (at home)	1.5	1.659	1.41
Percentage who have taken computer classes	39.7%	41.5% (n = 41)	
Mean # of computer classes taken	.794	1.073 (n = 41)	.86
Mean # of hours of software use per week	4.31	6.683	1.03
Overall system effectiveness rating	5.778	4.317	7.25*
Computer use for other tasks	88.9% have used computers for completing tasks other than pt care.	70.7% have used computers for completing tasks other than pt care.	
Mean system effectiveness score	3.911	3.281	5.36*
Mean self-efficacy score	4.286	3.439	6.06*

Figure 2.

Initial Model for the University Medical Center Group



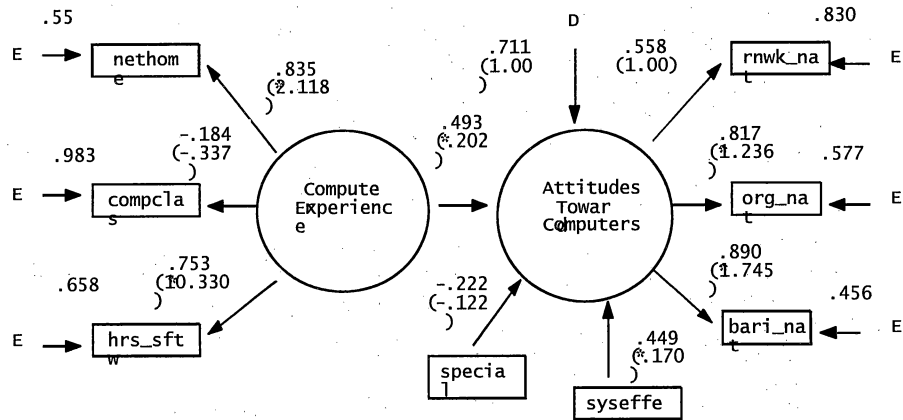
This model shows the significant paths for each variable

The comparative fit index (CFI) and the robust fit index (RFI) were both 1.0. The independence chi-square indicated that the variables were related and the fit indices indicated a good fit for the model. Since the LaGrange multiplier and Wald tests did not recommend adding or releasing any paths, post hoc model modifications were not performed.

The Community Hospital group was also evaluated (see Figure 3). A significant independence model chi-square of 119.658 [df = 28]; $p < .001$ was obtained. The CFI and RFI were .917 and .844 respectively. On the basis of the LaGrange multiplier test, post hoc model modifications were performed on this group.

Figure 3.

Initial Model for the Community Hospital Group

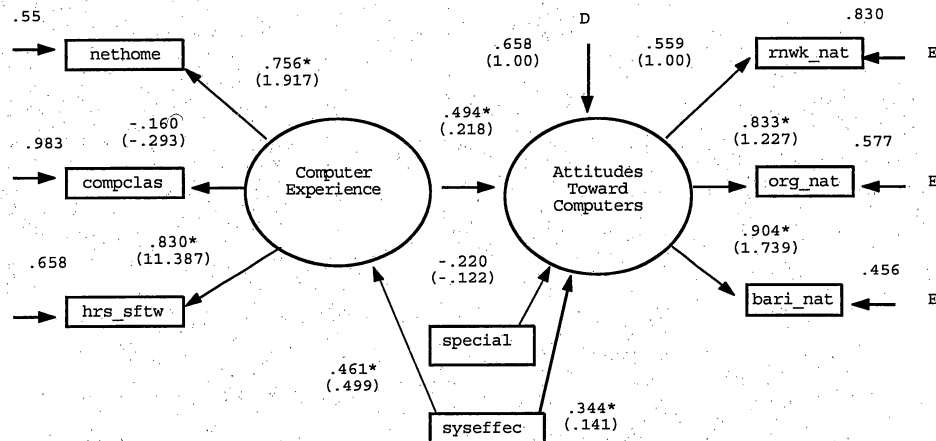


This model shows the significant paths for each variable

In an attempt to develop a better fitting model for the Community Hospital group, a path was added to the model predicting computer experience from system effectiveness (see Figure 4). While the independence model chi-square was unchanged ($\chi^2 = 119.658$ [df = 28]; $p < .001$) after adding the path, the CFI and RFI improved (.981 and .904 respectively). Therefore, the path was retained for the Community Hospital group.

Figure 4.

Initial Model for the Community Hospital Group (With a Path Added)



There is a path added that predicts computer experience from system effectiveness

After reviewing the models, the individual paths were evaluated. Evaluation of the individual paths indicated the following: 1) the number of computer classes taken (*compclas*) were not predicted from the factor computer experience in either group; 2) Internet use at home (*nethome*) and hours of software use (*hrs_sftw*) were predicted from computer experience for the Community Hospital group, but did not predict for the University Medical Center group; 3) two of the three NATC subscales (organizational issues {*org_nat*} and barriers to use {*bari_nat*}) were predicted from attitudes toward computers; 4) perceived system effectiveness were

predicted from attitudes toward computer use for both groups; and 5) nursing specialization was not predicted from attitudes toward computers for the Community Hospital group.

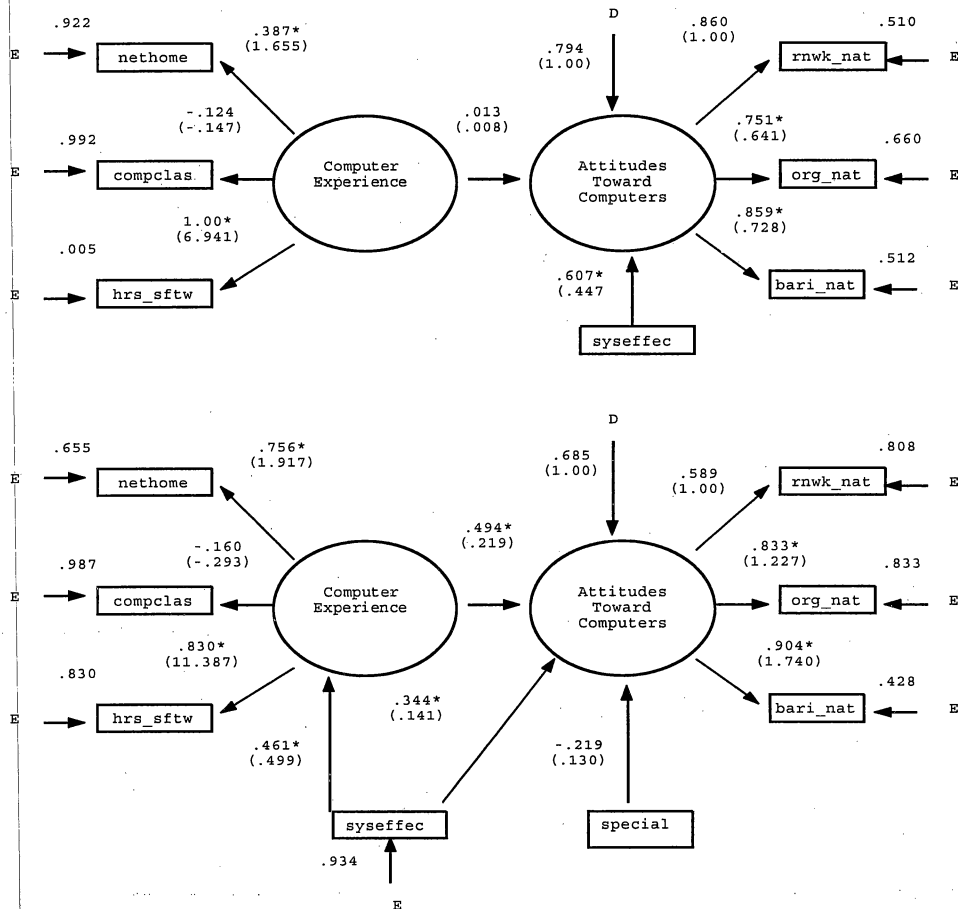
Therefore, H1 [greater prior computer experience as measured by 1) internet use, 2) computer classes and 3) number of software programs used, would predict strong positive attitudes toward computer use by nurses as measured by NATC scores] was rejected for the University Medical Center group and accepted for the Community Hospital group. H2 (nursing specialty will not predict attitudes toward computer use by nurses as measured by NATC scores) was not rejected for the Community Hospital group and not evaluated for the University Medical Center group. H3 (perceived computer system effectiveness would predict positive attitudes toward computer use by nurses as measured by NATC scores) was not rejected for either group.

To evaluate H4 (that the measurement models in both groups would be equivalent) and H5 (that the structural models in both groups would be equivalent), the University Medical Center group and the Community Hospital Group were compared simultaneously.

An initial evaluation was first completed to assess for overall model fit (see Figure 5).

Figure 5.

Initial Group Model



This shows the significant paths for each group

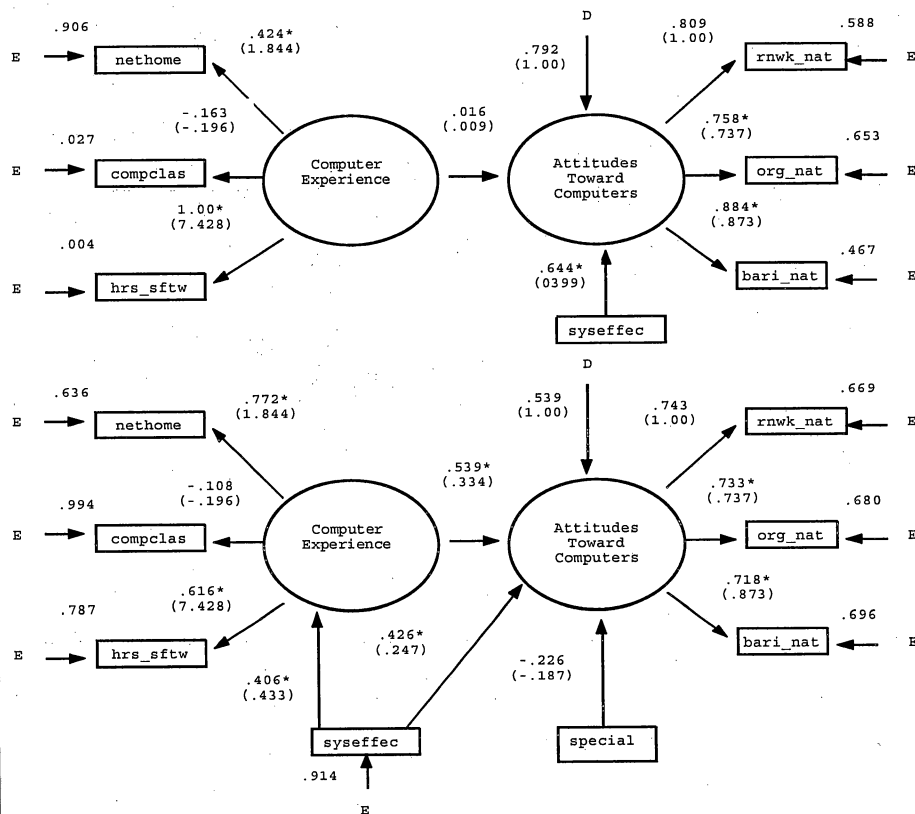
The model chi-square was used to assess how well the two groups fit a single model. The results of the first group model comparison showed that the model chi-square was not significant ($\chi^2 = 27.080$ [df = 32]; $p > .05$). The

CFI was 1.0. The chi-square indicated that the two groups were not significantly different. This allowed for further comparison of the measurement and structural paths for the two groups.

After determining that the model chi-square was not significant for the initial group evaluation, the groups' measurement paths were constrained (see Figure 6) and compared.

Figure 6.

Group Model with Measurement Paths Constrained



This shows the significant paths for each group

By constraining the measurement paths, the analyses simultaneously evaluated the same paths in each group. This is a more critical evaluation of the groups and their paths compared to non-constrained models.

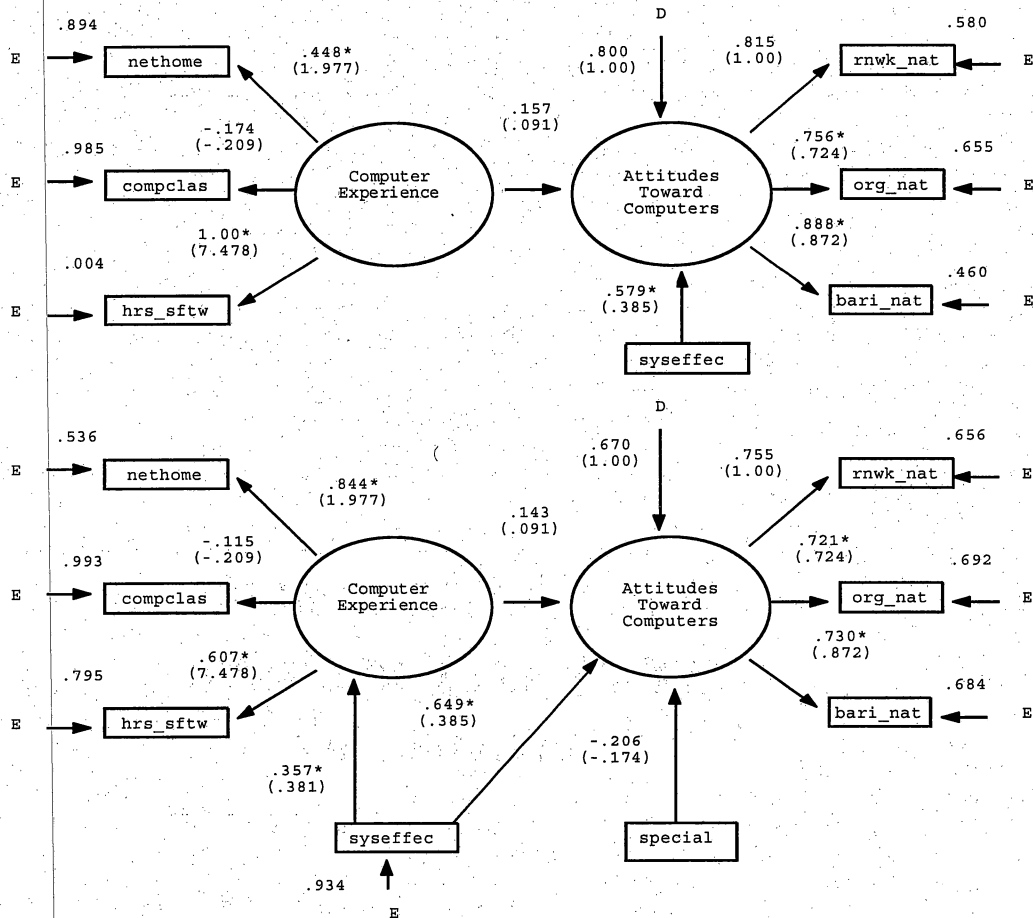
The model chi-square results from the constrained measurement model (H4) were not significant ($\chi^2 = 41.640$ [df = 37]; $p < .05$). The CFI was .977. The results indicated that the models were not different and that the paths were comparable for the two samples. While the results indicated that the models were not different, H4 was ultimately rejected due to the addition of the path for the Community Hospital group.

The two groups were then compared with the measurement and structural paths constrained (see Figure 7).

This comparison allowed for overall evaluation of the models. The structural paths specifically tested the hypothesis (H5) that computer experience predicts attitudes toward computers. The model chi-square ($\chi^2 = 49.218$ [df = 39]; $p < .05$) was not significant. The CFI was .950. Thus the results indicated that the structural model for the two group sample, were not different. H5 was supported; however, it should be noted

Figure 7.

Group Model with Measurement and Structural Paths
Constrained



This shows the significant paths for each group.

that while the paths were similar in each group, the path was not significant for either group.

Pearson correlations and standard deviations are presented in tables 3, 4, and 5 for the measured variables. These data are provided for the interested reader who may wish to replicate the SEM results. The

correlations are consistent with what was found with the SEM results.

Table 3.

Pearson Correlation Matrix and Standard Deviations for University Medical Center Measured Variables

	nethome	compclas	syseffec	hrs_sftw	org_nat	bari_nat	rnwk_nat	standard deviation
nethome	1.000							4.271
compclas	-.057	1.000						1.194
syseffec	-.063	-.076	1.000					.870
hrs_sftw	.387	-.124	-.024	1.000				6.941
org_nat	-.088	-.153	.559	-.014	1.000			.547
bari_nat	-.031	-.028	.508	-.036	.624	1.000		.543
rnwk_nat	.002	-.128	.484	-.016	.638	.755	1.000	.745

Table 4.

Pearson Correlation Matrix and Standard Deviations for Community Hospital Measured Variables

	special	nethome	compclas	syseffec	hrs_sftw	org_nat	bari_nat	rnwk_nat	Standard deviation
special	1.000								
nethome	-.010	1.000							2.536
compclas	.174	-.215	1.000						1.836
syseffec	-.045	.295	-.125	1.000					1.083
hrs_sftw	.103	.626	-.090	.415	1.000				13.712
org_nat	-.128	.510	-.066	.410	.476	1.000			.651
bari_nat	-.215	.393	-.026	.525	.418	.774	1.000		.851
rnwk_nat	-.163	.343	-.179	.578	.465	.400	.515	1.000	.752

Table 5.

Pearson Correlation Matrix and Standard Deviations for
Group (University Medical Center and Community Hospital)
Measured Variables

	special	nethome	compclas	syseffec	hrs_sftw	org_nat	bari_nat	rnwk_nat	Standard deviation
special	1.000								
nethome	-.081	1.000							3.701
compclas	.168	-.123	1.000						1.478
syseffec	-.409	.104	-.152	1.000					1.194
hrs_sftw	.145	.390	-.096	.112	1.000				10.168
org_nat	-.363	.127	-.0158	.617	.173	1.000			.667
bari_nat	-.463	.153	-.093	.670	.144	.766	1.000		.816
rnwk_nat	-.368	.132	-.186	.639	.158	.633	.717	1.000	.831

In summation, the following was supported in the above models. The single model for the University Medical Center group showed a significant relationship with only three of the variables (organizational issues and barriers to use were predicted from attitudes toward computers and system effectiveness predicted attitudes toward computers). No other paths were significant in this model.

However, the single group model for the Community Hospital found significant relationships with six of the variables (internet use at home, hours of software use at home were predicted by computer experience, system effectiveness which predicted computer experience and attitudes toward computer use, organizational issues,

barriers to use and computer experience which were predicted by attitudes toward computers).

The group model, in which the measurement and structural paths were constrained, predicted attitudes toward computers from system effectiveness for both groups (and computer experience from system effectiveness for the Community Hospital group). Furthermore, computer experience predicted Internet use at home and organizational issues and barriers to use were predicted from attitudes toward computers for both groups. However, the relationship of computer experience predicting attitudes toward computers was not significant for either group.

CHAPTER FIVE

DISCUSSION

The results of this study indicated that the two groups being compared were fairly similar. Some of the paths were predicted by attitudes toward computers or computer experience for each of the groups. However, since some of the paths were not significant, the differences that comprised each of the groups must be evaluated.

The two groups were comprised of nurses that came from different types of hospital environments (one group had nurses from a University Medical Center and the other had nurses from a Community Hospital). Even though only nurses were compared within each of the different hospital environments, one must consider that the different environments may attract different types of nurses. This would be a potential area for further research.

There were also some fundamental differences between the demographic makeup of each the groups. The University Medical Center group was comprised of ICU nurses and the Community Hospital group was comprised of three different nursing specialties (medical/surgical nurses, intermediate care nurses and ICU nurses). Additionally, the nurses came from two different types of hospital environments (a

University Medical center setting and a Community Hospital setting) and each hospital utilized a different type of computer charting system. The point of mentioning these fundamental differences is that different nursing specialties and hospital environments may attract different types of individuals (nurses).

While it is clear that there were some fundamental differences between the groups, certain results were consistent with what has been found by prior researchers (Bradley, 1993; Brodt & Stronge, 1986; Scarpa et al, 1992; Stronge & Brodt, 1985). Two of the NATC survey subscales loaded on the attitudes towards computers for both groups. However, a registered nurse's work did not load on attitudes toward computers (it was fixed to equal 1.00). Additionally, the hours of software use loaded on computer experience. The variable Internet use at home, while not evaluated by prior researchers, loaded on computer experience. Thus, the factors that loaded, represented a significant relationship between the factor and latent variable.

However, other hypotheses did not hold true. The number of computer classes taken did not represent computer experience, which contradicts what Bradley (1993) found. This difference may be due to any number of

factors, such as dissatisfaction with a given computer system, educational level, age or nursing specialty.

Furthermore, computer experience did not predict attitudes toward computers. The results related to prior research regarding this result are mixed (Bradley, 1993; McBride & Nagel, 1996; Scarpa et al., 1992; Sultana, 1990). The lack of significance with this path may simply be related to the small sample size used for this study. Since the parameter estimates in SEM are most stable with large samples (Ullman, 1996, p 715), this author would recommend evaluating this relationship using a larger sample before drawing conclusions related to potential differences.

There were additional data obtained for this study that may explain some of the differences between the groups. One factor may be related to the overall effectiveness of the computer charting system used by the different hospitals. The system effectiveness variable was used as a predictor variable for this study. It was used as a predictor variable because it measured the perceptions of the participants (versus measuring actual system effectiveness). While system effectiveness could be viewed as an outcome variable, it is important to note that perceptions could affect attitudes. Thus, perceived

differences between the groups could affect attitudes toward computer use.

The results of this study indicate that there was a difference in the mean effectiveness score between the two groups. The mean system effectiveness score was comprised of the mean responses to a series of questions related to computer charting. The University Medical Center nurses rated their system as "more effective" compared to the Community Hospital group (mean score of 3.91 versus 3.28; $t = 5.36$, $df=78$, $p < .05$). In addition, the overall system effectiveness (a single question that asked participants to rate their charting system on a 7 point scale) was rated higher for the University Medical Center group (mean score of 5.77 compared to 4.31 for the Community Hospital Group; $t = 7.25$, $df = 72$, $p < .05$). Therefore, there was a significant difference between the two groups.

Participants from the University Medical Center group had fairly positive beliefs regarding the Hewlett Packard system. As indicated in the literature, effectiveness of the computer charting system may effect attitudes toward the system (Bradley, 1993; McBride & Nagle, 1996; Scarpa et al, 1992; Sultana, 1990).

Additionally, the participants from the University Medical Center group had much greater length of home

computer ownership compared to the Community Hospital group (mean score of 55.81 months versus 17.29 months respectively; $t = 8.303$, $df = 99$, $p < .05$). However, according to Bradley (1993), mere length of computer ownership did not predict attitudes toward computers. Bradley (1993) found that frequency of computer use was more important in predicting attitudes toward computers. Therefore, data related to software use was collected. While the mean number of hours of software use was greatest for the Community Hospital group (6.68 compared to 4.31 for the University Medical Center group) the difference was not significant ($t = 1.03$, $df = 53$, $p > .05$).

Also, in the University Medical Center group, 61.9% of the nurses had at least a bachelors degree, while the Community Hospital group had only 39% with a bachelors or higher degree. Consequently, level of education may have also been a factor.

While there are many reasons why the hypotheses for this study were or were not significant, there are two areas that need to be critiqued further; 1) the sample size for this study and 2) the number of confounds that existed between the two groups. Recommendations for future research would include repeating this study utilizing a

larger and more equivalent sample size for each of the groups.

In addition to several recommendations for future research studies, this study does provide some practical implications. This study points out the importance of evaluating the point-of-care computer system selected for implementation. Careful evaluation of computer charting systems can help to reveal the benefits or greater practical purposes of one computer system when compared to others.

Additionally, it is important for organizational leaders to have an understanding that certain factors may increase or decrease resistance to change when a new point-of-care computer system is implemented. Thus, incorporating those factors that tend to decrease resistance, into system implementation plans, can serve to ease the challenges associated with change.

APPENDIX
QUESTIONNAIRE

Information Sheet

- 1) Read and sign the consent form.
- 2) Answer all questions on the demographic survey (4 pages) and the Nurses' Attitudes Toward Computer Use Questionnaire. If you have questions please call Steve Marks at 335-9937.
- 3) Separate the consent form from the questionnaires.
- 4) Place the completed survey and consent in a sealed envelope and place it in Steve Marks' work mailbox.
- 5) Please do not discuss your survey answers with anyone who has not completed the survey.

Thank you for your time and participation.

Nurses' Attitudes Toward Computer Use for Point-of-Care Charting

Informed Consent

The study in which you are about to participate is designed to examine nurses' attitudes toward computer use for point-of-care charting. The study is being conducted by Steven Marks, RN MS student, under the supervision of Jan Kottke, Ph.D., Professor of Psychology, California State University, San Bernardino. This study has been approved by the Department of Psychology Human Subjects Review Board, California State University, San Bernardino; Nurse Research Council, Loma Linda University Medical center; and the Loma Linda University Medical Center Institutional Review Board. Guidelines for conducting ethical research require that you must give your consent prior to participating in this study.

In this study you will be asked to complete an attitude questionnaire and demographic survey. The entire process should take less than 15 Minutes. Upon completion of the questionnaire and survey you can return it directly to Steven Marks or leave the informed consent and survey in a sealed envelop in his mailbox. All of your responses will be kept in the strictest confidences by the researcher. Your name will be reported with your responses. Data will be reported in group form only. You may receive the results after the study has been completed by contacting the researcher. The study should be completed by October, 1998.

Your participation in this study is totally voluntary. You are free to withdraw from this study at any time without penalty. After you complete the questionnaire, you will receive a debriefing statement describing the study in greater detail. If you have any questions regarding this study you may contact the researcher at 909-335-9937 or Dr. Kottke at 909-880-5585.

By signing in the space below, I acknowledge that I have been informed of, and that I understand the nature and purpose of the study. I further acknowledge that I am at least 18 years of age and freely consent to participate. Separate this consent form from the questionnaire. Turn in the consent form with the completed questionnaire. Please do not discuss your answers with anyone who has not completed the survey.

Signed: _____

Today's Date: _____

Demographic Data

Age: _____

Gender: _____ Male _____ Female

Highest Degree Obtained:

- _____ RN, Associate
- _____ RN, Baccalaureate
- _____ RN, Master
- _____ RN, Ph.D.
- _____ RN other (please list) _____
- _____ Non-nursing BA/BS
- _____ Non-nursing MA/MS
- _____ Non-nursing Ph.D.

Current Unit working on: _____

Number of years you have worked as a nurse? _____

Number of years you have worked at this hospital? _____

Prior to working at this hospital, did you use a computer for documenting patient care?

_____ Yes _____ No

Do you own a computer at home? _____ Yes _____ No

If so, how long have you owned one? _____

Do you have internet access at home? _____ Yes _____ No

If so, how many hours per week do you spend on the internet (i.e. 1 hour, 5 hours, 20 hours, etc)? _____

Have you taken any computer classes and/or workshop? _____ Yes _____ No

If so, how many classes have you taken (i.e. 1 class, 5 classes, etc)? _____

Approximately how many hours per week do you use the following software program?

Word Processing (i.e. MS Word, MS Works
WordPerfect)

Financial Programs (i.e. Quicken, Microsoft
Money)

Spreadsheet (i.e. Excel, Quattro Pro)

Presentation Software (i.e. Powerpoint)

Desktop Publishing (i.e. MS Publisher)

Scanning (i.e. Adobe Photo Deluxe)

Games (i.e. Golf, Flight Simulator, War
Games, Dungeons and Dragons)

Programming (i.e. Basic, C+)

Educational (i.e. Math, Foreign Language)

Organizer/scheduler (i.e. Ascend)

Graphic Design (i.e. Corel Draw)

Other/s Please list _____

Questions related to the current computer system you are using for bedside charting:

Please rate how effective the computer system you are using is for documenting
patient care?

Not at all effective

Extremely effective

1

2

3

4

5

6

7

How long have you been using a computer to document patient care **AT THIS
FACILITY?**

Prior to using a computer for documenting patient care, did you use a computer for
other tasks (i.e. ordering medications, checking lab results)? ____ Yes ____ No

Please rate each of the following aspects of the computer system you are currently using for charting patient care. Use the following scale:

	Very Poor			Excellent	
	1	2	3	4	5
Automatic computer carryover of information (default settings).	1	2	3	4	5
Speed of Charting.	1	2	3	4	5
Legibility of charting	1	2	3	4	5
Initial training for system use.	1	2	3	4	5
Continual training for system changes.	1	2	3	4	5
Ease of keyboard to enter data.	1	2	3	4	5
Ability to locate medication information in the computer chart.	1	2	3	4	5
Ability to locate vital signs information in the computer chart.	1	2	3	4	5
Ability to locate laboratory results information in the computer chart.	1	2	3	4	5
Performs Input/Output calculations.	1	2	3	4	5
One location for nursing documentation	1	2	3	4	5
Calculates IV medication administration rates	1	2	3	4	5
Steps or screens required to obtain charted medical information.	1	2	3	4	5
Step or screens required to go through to chart medical information	1	2	3	4	5
Printing of records.	1	2	3	4	5
Use for shift report (i.e. Current Nursing care Directives).	1	2	3	4	5
Use of computerized Nursing care plan.	1	2	3	4	5
Use of computerized Medication Administration Record (MAR).	1	2	3	4	5

Patient confidentiality protection measures.	1	2	3	4	5
System speed.	1	2	3	4	5
Number of computer terminals or handheld for charting.	1	2	3	4	5
System design Computer station.	1	2	3	4	5
System design key board or touch pad	1	2	3	4	5
System is easy for Registry o per diem nurses to learn.	1	2	3	4	5
Switching between patient information screens.	1	2	3	4	5
Other-Please list _____.	1	2	3	4	5

Please rate the following:

	Strongly Disagree	Disagree Somewhat	Agree	Agree Somewhat	Strongly Agree
I have confidence in my ability to use the computer charting system.	SD	DS	A	AS	SA
I am very proud of my skills and abilities related to using this computer system for charting patient care.	SD	DS	A	AS	SA
I am an expert in using this computer system.	SD	DS	A	AS	SA
There are some tasks related to using this computer system for charting that I cannot do well.	SD	DS	A	AS	SA
Most people on this unit can use the computer system more effectively than I can	SD	DS	A	AS	SA

Nurses' Attitudes Toward Computerization Questionnaire

Copyright to Dr. James H. Stronge, 1985

Instructions

It should not take longer than 10 minutes to complete this questionnaire. Do not omit any item. Read each statement carefully, then select one of the five responses. Give your first reaction and response to the statement. Circle only one answer for each statement.

SA = Strongly Agree A = Agree U = Uncertain D = Disagree SD = Strongly Disagree

- | | | | | | | |
|----|--|----|---|---|---|----|
| 1. | A computer increases cost by increasing the nurses' workload. | SA | A | U | D | SD |
| 2. | Computers cause a decrease in communication between hospital departments. | SA | A | U | D | SD |
| 3. | Computers will allow the nurse more time for the professional tasks for which he/she is trained. | SA | A | U | D | SD |
| 4. | Part of the increase in costs of health care is because of computers. | SA | A | U | D | SD |
| 5. | The time spent using a computer is out of proportion to the benefits. | SA | A | U | D | SD |
| 6. | Computers represent a violation of patient privacy. | SA | A | U | D | SD |
| 7. | Only one person at a time can use a computer terminal; therefore, staff efficiency is inhibited. | SA | A | U | D | SD |
| 8. | Computerization of nursing data offers nurses a remarkable opportunity to improve patient care. | SA | A | U | D | SD |
| 9. | Computers contain too much personal data to be used in an area as open as a nursing station. | SA | A | U | D | SD |

10.	Computers cause nurses to give less time to quality patient care.	SA	A	U	D	SD
11.	If I had my way, nurses would never have to use computers.	SA	A	U	D	SD
12.	Computers should only be used in the financial department.	SA	A	U	D	SD
13.	Computers make nurses' jobs easier.	SA	A	U	D	SD
14.	Paperwork for nurses has been greatly reduced by the use of computers.	SA	A	U	D	SD
15.	Orientation for new employees takes longer because computers and, therefore, unnecessary work delays occur.	SA	A	U	D	SD
16.	Nursing information does not lend itself to computers.	SA	A	U	D	SD
17.	Computers save steps and allow the nursing staff to become more efficient.	SA	A	U	D	SD
18.	The more computers in an institution, the less number of jobs for employees.	SA	A	U	D	SD
19.	Increased computer usage will allow nurses more time to give patient care.	SA	A	U	D	SD
20.	Because of computers, nurses will face more lawsuits.	SA	A	U	D	SD

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